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(72) Inventor SAAD ZAGHLOUL MOHAMMED GABR

(19)

(54) IMPROVEMENTS IN OR RELATING TO SOUND REPRODUCTION SYSTEMS

(71) We, A.R.D. TECHNICAL ASSISTANCE AND ENGINEERING SERVICES INTERNATIONAL ANSTALT, of P.O. Box 34613, 9490 Vaduz, Liechtenstein, a body corporate organised under the laws of Liechtenstein, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to amplifier and sound reproduction systems for amplifying and reproducing an input signal covering at least a major part of the audio-frequency range.

Amplifier and sound reproduction systems in which an electrical signal to be reproduced as sound is divided into three or more signals each substantially confined to a respective part only of the audio frequency spectrum (say 20 to 20,000 Hz) provide considerable advantages; in particular they make it possible to feed the signal to a plurality of loudspeaker units without the need to interpose cross-over networks. Where the loudspeaker units are to be spaced remotely from the amplifier, however, the disadvantage arises that three or more wires are required to extend between the amplifier station and the loudspeaker station.

The invention accordingly provides an amplifier and sound reproduction system for amplifying and reproducing an input signal covering at least a major part of the audio-frequency range, the system comprising:

(1) an amplifier station having:

(a) first multi-section filter means for receiving and dividing the input signal into at least three signals each covering substantially only a part of the audio-frequency range;

(b) at least three variable output amplifiers each for receiving a respective one of the divided signals; and

(c) means for combining the outputs of the amplifiers to form an amplifier station output;

(2) a multi-channel loudspeaker station located remotely from the amplifier station and having:

(i) second multi-section filter means for receiving and dividing the amplifier station output into at least three signals each covering substantially only part of the audio-frequency range; and

(ii) loudspeaker means for receiving the second multi-section filter means outputs;

(3) means for conveying the amplifier station output to the loudspeaker station; and

(4) a compensation circuit in one of the amplifier and loudspeaker stations, for boosting the upper and lower frequency portions of the signal prior to the application thereof to the respective multi-section filter in inverse relation to the frequency response characteristics of the loudspeaker means.

The loudspeaker means may comprise at least three separate loudspeaker units for receiving respective ones of the at least three signals from the output of said second multi-section filter means. Alternatively the at least three signals from the output of said second multi-section filter means are combined prior to the application thereof to the loudspeaker means. Otherwise, the loudspeaker means may comprise at least a plurality of separate loudspeaker units, and less than all of the at least three signals from the output of said second multi-section filter means are combined prior to the application thereof to the loudspeaker means.

Advantageously, the loudspeaker station further comprises amplifier means for amplifying the outputs of the second multi-section filter means prior to the application thereof to the loudspeaker means.

The present invention will be more readily understood from the following illustrative description and the accompanying drawing, in which:

Fig. 1 shows in block schematic form the circuits of an amplifier station and a loudspeaker station connected to form a sound amplifier and sound reproduction system.

Fig. 2 shows again in block schematic form a modified form of loudspeaker station; and

Fig. 3A and 3B show respectively illustrative

frequency response areas of a compensation circuit and of an electromagnetic loudspeaker.

The circuit of Fig. 1 comprises an amplifier station A and a loudspeaker station L. The circuit will normally be employed as one channel only of a stereophonic or quadrophonic system. The amplifier station A includes selection means 10 for selection of an input signal from a plurality of inputs, and a preamplifier 12 preferably of variable output as shown. The preamplifier output is supplied to a multi-section filter 30 in which the incoming signal is divided into five signals each arranged to cover substantially only a respective part of the full audio frequency range. Each output signal of the filter 30 is fed to a respective one of five variable output amplifiers 32, 34, 36, 38 and 40, the outputs of which are combined to provide an output for the amplifier station A. In the illustrated circuit, the outputs are combined in a mixer amplifier 52 which may be a variable output amplifier as well as or instead of the preamplifier 12. The output of the mixer amplifier 52 thus comprises the output of the preamplifier 12, after sub-division into five parts and selective amplification of these parts to obtain a desired balance between the upper and lower frequency portions of the audio frequency range.

The amplifier station output is applied to loudspeaker station L which is remotely positioned. Transmission between the amplifier station A and the loudspeaker station L of the single mixed signal at the output of amplifier 52 can be effected in any convenient way, for example, directly by a wire connection 54 which may or may not be shielded, according to the circumstances of use. Instead, however transmission between the two stations can be effected without a physical connection, as by a radio link. For this purpose, the amplifier station is provided with a transmitter 56 and the loudspeaker station with a receiver 58, the wire 54 being then omitted.

In the loudspeaker section L, the signal corresponding to the output of the mixer amplifier 52 received on either the wire 54 or the receiver 58 is applied to a multi-section filter 60 which can correspond to the multi-section filter 30 in the amplifier station A. The five outputs of the multi-section filter 60 will thus substantially correspond to the signals at the outputs of the variable gain amplifiers 32, 34, 36, 38, 40. These outputs can be applied directly to respective loudspeaker units 62, 64, 66, 68, 70, but they may be amplified prior to this in respective amplifiers 72, 74, 76, 78, 80, between the outputs of the multi-section filter 60, and the inputs to the loudspeakers 62, 64, 66, 68, 70. The amplifier 72, 74, 76, 78, 80 may be fixed output amplifiers, as all necessary control functions can be exercised in the amplifier station A. However, provision may be made for variable output amplifiers in the loudspeaker station L, so that these may be for example preset to suit particular acoustic conditions. Also, the or less than all of the separate signals from the multi-section filter 60 may be combined prior to the application thereof to the loudspeakers 62, 64, 66, 68, 70.

The multi-section filters 30, 60 can if desired effect division of the signals they received into different numbers of output signals and/or output signals of different frequency range. The equipment at either station can be battery powered if this is preferred to mains operation.

Although shown as being used in association with the loudspeaker station L, the amplifier station A can be employed with any other loudspeaker arrangement including a single loudspeaker unit whether located remotely or not and also with a transmitter system. The loudspeaker station can also be used in a loudspeaker telephone system, when relatively few separate channels need normally be employed, because of the relatively low sound reproduction quality usually required.

Fig. 2 shows a group of five loudspeaker sub-stations 90, 92, 94, 96 and 98. Normally the sub-stations of such a group will be of similar constructions, but for purposes of illustration, the group contains sub-stations of three different kinds. Each of the five sub-stations has a loudspeaker unit 100, 102, 104, 106 and 108, which may be replaced by a plurality of loudspeaker units of desired, and a variable output amplifier 110, 112, 114, 116 and 118 for supplying the associated loudspeaker unit, but the amplifiers receive their inputs in different ways. For sub-stations 90, 92 and 94, an input signal normally covering at least a major part of the audio frequency range is carried on line 99 to all the sub-stations for reception by a filter such as the filters 120, 122 and 124 which select respective parts only of the audio frequency for amplification by the associated amplifiers. The signal may not be carried all the way from the source of the wire 99 but by wire-less transmission for example a radio link including a receiver 101.

The sub-stations 96, 98 are arranged to receive a signal covering substantially a part only of the audio frequency range, so they contain no filter means. Such a signal can be derived for example from any source after treatment by a multi-section filter to obtain the separate signals required for the separate sub-stations. In sub-station 96 reception is by a wire-less link so a radio receiver 126 is provided and in sub-station 98 the signal is received directly on a wire 128.

Either of the stations or sub-stations described above includes an electronic compensation circuit for modifying the undivided signal, for example to compensate for non-linearity in the response curve of the associated loudspeaker unit or units. Thus if a

loudspeaker has a frequency response curve as indicated in Fig. 3A, the compensation circuit can be arranged to modify a substantially flat input signal to have a response curve as shown in Fig. 3B.

Comparison of Figs. 3A and 3B will show that in the absence of other factors the effective sound output of the loudspeaker will be approximately flat over the entire audio frequency range. The compensation circuit can of course be arranged to produce an effective sound output which has another shape than generally level, if this is desired for example to deal with special acoustic conditions. The circuit may also include means for selective adjustment of its characteristics in particular its frequency response curve.

The present invention will be seen to provide an amplification and sound reproduction system and amplifier and loudspeaker stations for use in such systems which are capable of the highest sound quality and which can provide any required degree of control flexibility, permitting selective amplification or omission of each of the frequency bands into which the signal is divided. Although five frequency bands are provided for in the illustrated system, at least three are suitable, and more, for example nine, such bands can advantageously be employed. Each loudspeaker unit shown could be replaced by a group of loudspeaker units in series or parallel.

Attention is drawn to the amplifier and sound reproduction system disclosed and claimed in Patent No. 1,502,595.

WHAT WE CLAIM IS:—

1. An amplifier and sound reproduction system for amplifying and reproducing an input signal covering at least a major part of the audio-frequency range, the system comprising:

(1) an amplifier station having:

(a) first multi-section filter means for receiving and dividing the input signal into at least three signals each covering substantially only a part of the audio-frequency range;

(b) at least three variable output amplifiers each for receiving a respective one of the divided signals; and

(c) means for combining the outputs of the amplifiers to form an amplifier station output;

(2) a multi-channel loudspeaker station located remotely from the amplifier station and having:

(i) second multi-section filter means for receiving and dividing the amplifier station output into at least three signals each covering substantially only part of the audio-frequency range; and

(ii) loudspeaker means for receiving the second multi-section filter means outputs;

(3) means for conveying the amplifier station output to the loudspeaker station; and

(4) a compensation circuit in one of the amplifier and loudspeaker stations, for boosting the upper and lower frequency portions of the signal prior to the application thereof to the respective multi-section filter in inverse relation to the frequency response characteristics of the loudspeaker means.

2. A system as claimed in claim 1, wherein the loudspeaker means comprises at least three separate loudspeaker units for receiving respective ones of the at least three signals from the output of said second multi-section filter means.

3. A system as claimed in claim 1, wherein the at least three signals from the output of said second multi-section filter means are combined prior to the application thereof to the loudspeaker means.

4. A system as claimed in claim 1, wherein the loudspeaker means comprises at least a plurality of separate loudspeaker units, and less than all of the at least three signals from the output of said second multi-section filter means are combined prior to the application thereof to the loudspeaker means.

5. A system as claimed in any preceding claim, wherein the loudspeaker station further comprises amplifier means for amplifying the outputs of the second multi-section filter means prior to the application thereof to the loudspeaker means.

6. A system as claimed in any preceding claim, wherein the compensation circuit is connected to supply the associated multi-section filter.

7. A system as claimed in any preceding claim, wherein the means for conveying the amplifier station output to the loudspeaker station comprises a radio transmission link.

8. A system as claimed in any of claims 1 to 6, wherein the means for conveying the amplifier station output to the loudspeaker station comprises a single pair of wires.

9. A system as claimed in any preceding claim, wherein the loudspeaker station comprises a plurality of physically separate loudspeaker sub-stations.

10. An amplifier and sound reproduction system substantially as hereinbefore described with reference to the accompanying drawing.

POLLAK MERCER & TENCH,
Chartered Patent Agents,
Eastcheap House,
Central Approach,
Letchworth,
Hertfordshire SG6 3DS,
— and —
High Holborn House,
52—54 High Holborn,
London WC1V 6RY.
Agents for the Applicants.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1

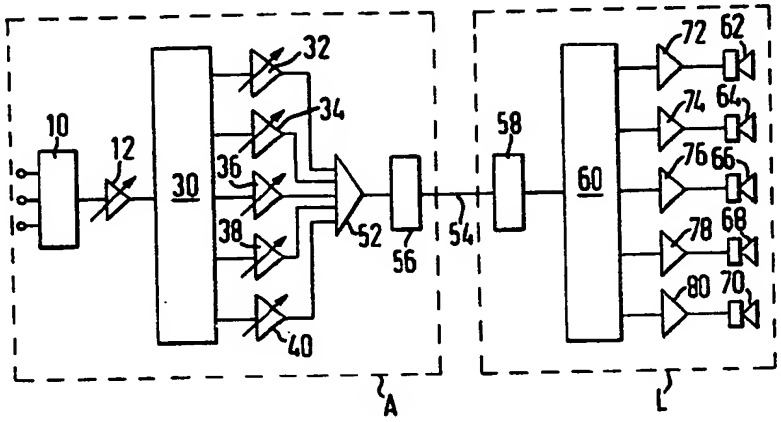


FIG. 2

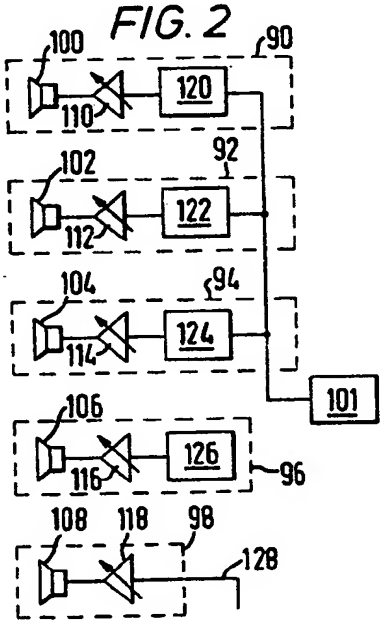


FIG. 3A

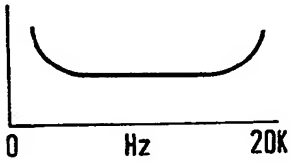
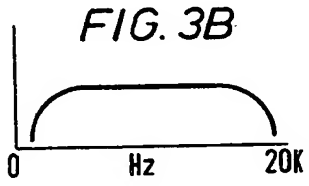


FIG. 3B



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